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(71) Applicant *(for all designated States except US)*: **SUPER DIMENSION LTD.** [IL/IL]; P.O.Box 2045, 46120 Herzeliya (IL).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **GREENBURG, Benny** [IL/IL]; 16 Lotem St., 45100 Hod Hasharon (IL). **BELCHER, Danny** [IL/IL]; 10 Yehuda St., 52504 Ramat Gan (IL). **GRIEFNER, Gil** [IL/IL]; 12 Itamar St., 52531 Ramat Gan (IL). **BECKER, Heinrich** [DE/DE] (DE).

(74) Agent: FRIEDMAN, Mark; 7 Jabotinsky St., 52520 Ramat Gan (IL).

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(54) Title: SYSTEM OF ACCESSORIES FOR USE WITH BRONCHOSCOPES

(57) Abstract: A clip or flexible handles extension facilitate simultaneous retention and operation of a bronchoscope and associated bronchoscopic tools held in one hand to allow operation by a single practitioner. Also provided is an adapter for the connection port of the working channel of a bronchoscope which performs both sealing and tool-locking functions. Also disclosed is a guide sheath arrangement with a reduced flexibility proximal portion to facilitate insertion of tools into the guide sheath.

System of Accessories for Use with Bronchoscopes

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to bronchoscopy and, in particular, it concerns a system of accessories for use when performing surgical procedures using a bronchoscope.

The most common interventional procedure in the field of Pulmonary Medicine (i.e., medicine pertaining to the respiratory system) is bronchoscopy, in which a bronchoscope is inserted into the airways through the patient's nose or mouth. The instrument consists of a long, thin, flexible tube that typically contains three elements, an illumination arrangement for illuminating the region distal to the bronchoscope's tip via an optical fiber connected to an external light source, an imaging arrangement for delivering back a video image from the bronchoscope's distal tip, and a 'working channel' through which instruments of both diagnostic (e.g., biopsy tools) and therapeutic (e.g., laser, cryo or RF tissue elimination probes) nature are inserted. The distal tip of the bronchoscope is steerable; rotating a lever placed at the handle of the bronchoscope actuates the steering mechanism by deflection the tip in two opposite directions.

Bronchoscopies are applied routinely to the diagnosis and treatment of diseases such as Lung Cancer, Airway Stenosis, and Emphysema. They are performed by an expert pulmonologist, also known as a bronchoscopist.

Bronchoscopies are performed by a staff of at least two persons, the bronchoscopist and at least one assistant, usually a nurse. During a typical procedure, the bronchoscopist holds the bronchoscope handle with one hand and the bronchoscope tube with the other hand. He or she manipulates the distal tip of the bronchoscope inside the lung by rotating the deflection lever and by pushing and pulling the tube. Once the tip is brought to the target, a medical diagnosis is achieved and/or treatment is applied by insertion of a bronchoscopic tool into the working channel and out through the distal tip of the bronchoscope tube and performing the diagnosis or treatment.

During insertion and operation the bronchoscopic tool, the distal tip of the bronchoscope should be held steady at the target. Performing all of these tasks concurrently often requires three or four hands, two for securing the bronchoscope in place, and one to two more hands for inserting and actuating the bronchoscopic tool. The complexity of such multi-person operation, requiring delicate coordination between the physician and the assistant, often detracts from the resulting precision of the medical procedure, and the need for additional helping hands often increases its cost.

Of particular relevance to the present invention is a device and method described in PCT patent application publication no. WO 03/086498 entitled "Endoscope Structure and Techniques for Navigation in Brunched Structure" to Gilboa, which is hereby incorporated fully by reference. This patent application describes a method and apparatus in which a locatable guide ("LG"), enveloped by a sheath, is used to navigate a bronchoscopic tool to a location within the lung. The guide/sheath combination is inserted into the lung via the working channel of a bronchoscope. Once the tip of the guide is located at its target, a lock, which is placed at the orifice ("connection port") of the bronchoscope's working channel, is operated to prevent the sheath from sliding in or out of the bronchoscope. The guide is then withdrawn from the sheath, leaving the sheath in place to guide a tool to the required target location.

On the other hand, when the same bronchoscope is used in its primary function for investigation of the bronchi, the same working channel is used to clean disturbing mucus from the airways, using a vacuum pump connected to special connector separate from the orifice of the working channel. For the suction to work properly, the orifice of the working channel should be sealed during application of the suction.

It follows that, during the procedure, the physician typically needs to interchange two different devices to the connection port of the bronchoscope working channel, a seal and a lock, and these must be interchanged depending upon which function the bronchoscope is currently performing.

During the switch between locatable guide and other tools, it is necessary to insert the guide or tool into the free proximal end of the sheath. This step has been found to be somewhat "fiddly" and difficult to achieve quickly due to the flexibility and consequent mechanical instability of the end of the sheath. The problem can be addressed easily by holding the end of the sheath in one hand and the tool in another, but this would again require additional free hands during performance of the procedure.

In order to facilitate operation of a system such as described in the aforementioned application by a single practitioner, it would be preferable to allow the practitioner to temporarily release his or her grip on a secondary tool or device used via the working channel of the bronchoscope. At the same time, it is preferable that the device remains immediately accessible and operable, and does not hang loosely.

There is therefore a need for accessories for use with a bronchoscope which would facilitate operation of a bronchoscope and associated tools by a single practitioner. It would also be advantageous to provide an adapter for the connection port of the working channel of a bronchoscope which would perform both the sealing and tool-locking functions without requiring replacement of an attachment during the procedure. It would further be advantageous to provide an arrangement according to the teachings of the aforementioned PCT patent publication which would facilitate insertion of tools into the guide sheath.

SUMMARY OF THE INVENTION

The present invention relates to various accessories for use when performing surgical procedures using a bronchoscope.

According to the teachings of the present invention there is provided, a sealing and locking adapter for attachment to an access port of a working channel of a bronchoscope to allow insertion and locking of a tool while sealing the access port when not in use, the adapter comprising: (a) a housing configured for mating with the access port of the working channel of the bronchoscope; (b) an attachment configuration associated with the housing and configured for attaching the housing to the access port of the working channel; (c) a sealing arrangement deployed within the housing, the sealing arrangement including an elastomeric valve elastically biased to a normally-closed state wherein the elastomeric valve forms part of a sealing arrangement for resisting passage of air through the access port of the working channel, the elastomeric valve being configured to allow insertion of the tool through the valve and into the working channel; and (d) a clamping arrangement deployed within the housing, the clamping arrangement including an elastomeric clamping block and a tightening mechanism, the tightening mechanism being manually operable to deform the elastomeric clamping block so as to lock in position the tool inserted through the housing and into the working channel.

According to a further feature of the present invention, the elastomeric clamping block is formed as a substantially cylindrical collar with a central clamping bore for passage of the tool.

According to a further feature of the present invention, the central clamping bore features at least one inwardly projecting ridge.

According to a further feature of the present invention, the substantially cylindrical collar has at least one conical surface portion, the tightening mechanism including an axially displaceable element deployed for engaging the at least one conical surface so as to apply an inward locking pressure on the central clamping bore.

According to a further feature of the present invention, the elastomeric valve and the elastomeric clamping block are implemented as a unitary elastomeric insert deployed within the housing.

According to a further feature of the present invention, the elastomeric valve is implemented as an elastomeric membrane cut along a slit.

There is also provided according to the teachings of the present invention, a clip for temporarily retaining a substantially cylindrical body portion of an accessory in predefined relation to a handle of a bronchoscope, the clip comprising: (a) an outer bracket configured for circumscribing at least 180° around the handle of the bronchoscope; (b) a flexible clamping portion deployed within the outer bracket and circumscribing at least 180° around the handle of the bronchoscope; (c) a tightening mechanism associated with the outer bracket and configured to flex at least part of the flexible clamping portion inwards relative to the outer bracket so as to clamp the clip onto the handle of the bronchoscope; and (d) a pair of resilient jaws interconnected with at least one of the outer bracket and the flexible clamping portion, the pair of resilient jaws being configured for gripping an accessory.

According to a further feature of the present invention, there is also provided a resilient insert deployed within the clamping portion.

According to a further feature of the present invention, the pair of resilient jaws is integrally formed with the flexible clamping portion.

According to a further feature of the present invention, the pair of resilient jaws is configured to grip the substantially cylindrical body portion of the accessory substantially perpendicular to a direction of elongation of the bronchoscope handle.

According to a further feature of the present invention, the flexible clamping portion circumscribes at least about 200° around the handle of the bronchoscope.

According to a further feature of the present invention, the flexible clamping portion circumscribes no more than about 250° around the handle of the bronchoscope.

There is also provided according to the teachings of the present invention, a wrap-around handle extension for use with a bronchoscope handle, the wrap-around handle extension comprising: (a) a flexible wrap-around layer provided with complementary fastening arrangements deployed so as to form a conical sleeve for holding the bronchoscope handle; and (b) a hand loop associated with the flexible wrap-around layer and configured for receiving the hand of a user to allow suspension of the conical sleeve from the hand of the user.

According to a further feature of the present invention, the complementary fastening arrangements are implemented as complementary regions of a Velcro fastening arrangement.

According to a further feature of the present invention, there is also provided an accessory suspension strap associated with the flexible wrap-around layer and configured for suspending an accessory from the conical sleeve.

According to a further feature of the present invention, the accessory suspension strap is configured with a releasable fastening configuration to form a releasable suspension loop.

There is also provided according to the teachings of the present invention, a sheath for deployment via a working channel of a bronchoscope for directing a tool to a previously identified position, the sheath comprising: (a) a primary sheath portion extending along a major portion of a length of the sheath, the primary sheath portion having a first degree of flexibility; and (b) a reduced flexibility proximal sheath portion, the proximal sheath portion and the primary sheath portion together defining a contiguous inner lumen, the proximal sheath portion having a lower degree of flexibility than the primary sheath portion.

According to a further feature of the present invention, the primary sheath portion is implemented as a tube formed from a first material, and wherein the proximal sheath portion is implemented as a continuation of the tube formed from the first material circumscribed by a reinforcing sleeve of a second material.

According to a further feature of the present invention, there is also provided a distal sheath portion forming a contiguous inner lumen with the primary sheath portion, the distal sheath portion having a higher degree of flexibility than the primary sheath portion.

According to a further feature of the present invention, there is also provided a proximal end piece mechanically associated with a proximal end of the proximal sheath portion, the proximal end piece defining a conical insertion guide for guiding a tool into the inner lumen.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic isometric view of part of the handle of a bronchoscope showing a working channel fitted with a sealing and locking adapter, constructed and operative according to the teachings of the present invention;

FIG. 2A is an enlarged schematic isometric view showing the adapter of Figure 1 prior to attachment to the bronchoscope's handle;

FIG. 2B is an enlarged schematic isometric view showing the adapter of Figure 1 attached to the bronchoscope's handle;

FIG. 3A is an exploded isometric view illustrating the components of the adapter of Figure 1;

FIG. 3B is an isometric view of the adapter of Figure 1 when assembled;

FIG. 4 is an axial cross-sectional view taken through the adapter of Figure 1;

FIG. 5 is a schematic longitudinal cross-sectional view taken through a variable flexibility sheath constructed and operative according to the teachings of the present invention;

FIG. 6 is an isometric view of a bronchoscope accessory clip constructed and operative according to the teachings of the present invention;

FIG. 7 is a disassembled view of the clip of Figure 6 indicating the sequence of assembly;

FIG. 8 illustrates mounting the clip of Figure 6 on a bronchoscope;

FIG. 9 illustrates the clip of Figure 6 in use to retain a bronchoscope accessory;

FIG. 10 is a side view of a wrap-around handle extension, constructed and operative according to the teachings of the present invention, in a flattened state;

FIG. 11 is a side view of the wrap-around handle extension of Figure 10 in a deployed state forming a conical sleeve for holding a bronchoscope handle;

FIG. 12 is a side view illustrating the use of the wrap-around handle extension of Figure 10 with a bronchoscope and an accessory during a first stage of a procedure; and

FIG. 13 is a side view illustrating the use of the wrap-around handle extension of Figure 10 with a bronchoscope and an accessory during a second stage of a procedure.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to various accessories for use when performing surgical procedures using a bronchoscope.

The principles and operation of bronchoscope accessories according to the present invention may be better understood with reference to the drawings and the accompanying description.

By way of introduction, it should be noted that the present invention includes a number of different aspects, each of which is believed to be of patentable significance in its own right. Specifically, with reference to Figures 1-4, a sealing and locking adapter will be described. Then, with reference to Figure 5, a preferred sheath structure will be described. Then, with reference to Figures 6-9, a clip structure for retaining an accessory tool will be described. Finally, with reference to Figures 10-13, a wrap-around handle extension arrangement will be described.

Referring now to the drawings, Figure 1-4 illustrate a first aspect of the present invention, namely, a sealing and locking adapter **200** for attachment to an access port ("interface") **110** of a working channel **130** of a bronchoscope **100** to allow insertion and locking of a tool (not shown) while sealing the access port **110** when not in use. Generally speaking, as best seen in Figure 4, adapter **200** includes a housing **13** configured for mating with the access port **110** and an attachment configuration associated with housing **13** and configured for attaching housing **13** to access port **110** of working channel **130**. Adapter **200** includes a sealing arrangement, deployed within housing **13**, including an elastomeric valve **20** elastically biased to a normally-closed state (Figure 4) wherein elastomeric valve **20** forms part of a sealing arrangement for resisting passage of air through the access port **110** of working channel **130**. Elastomeric valve **20** is also configured to allow insertion of a tool (not shown) through the valve and into the working channel. Also deployed within housing **13** is a clamping arrangement including an elastomeric clamping block **11** and a tightening mechanism manually operable to deform elastomeric clamping block **11** so as to lock in position a tool inserted through housing **13** and into the working channel **130**.

At this stage, it will be immediately clear that adapter **200** provides major advantages over the prior art. Specifically, by providing both a sealing arrangement and a locking configuration within a single adapter, the aforementioned problem of needing to replace the attachments during performance of different parts of a surgical procedure. This and other advantages of this aspect of the present invention will become clearer from the detailed description below.

Referring now specifically to Figure 1, this shows a schematic drawing of the handle **100** of a bronchoscope. A working channel **130** is included inside handle **100**. Tools are inserted into the working channel through an input orifice **125**. The working channel is incorporated inside the entire length of the bronchoscope all the way up to its proximal end. In addition, the working channel is also connected to a vacuum pump (not shown) or other source of suction through a valve **140** and through a second connector **160**. When the valve is pressed open, the pump sucks the content of the working channel. For the suction to work properly, the working channel should be kept sealed. A gasket fitting **120** is incorporated at the entrance of the working channel on which a rubber gasket can be attached for sealing the orifice (not shown).

In a preferred embodiment, adapter **200** is mounted on the working channel interface **110** by connection to the gasket fitting **120**. Figures 2A and 2B show a preferred attachment configuration for connecting the adapter **200** to the working channel interface **110**. Adapter **200** accepts a forked key **14** into a lateral slot **24**. The forked key holds adapter **200** attached to the interface by engaging the undercut sides of fitting **120**. The shape of the housing **13** of the apparatus is matched to the shape of the interface **110** and includes side walls extending so as to form a groove or channel **21** which cooperates with the body of the bronchoscope handle to prevent rotation of housing **13**. Thus, housing **13** is first positioned so as to envelop the interface **110**, and than the forked key **14** is inserted into slot **24** to attach and maintain contact pressure between adapter **200** and the working channel orifice.

Figures 3A, 3B and 4 show the combined locking and sealing adapter in more detail. When placed on top of the working channel, its lower surface **22** is pressed against the gasket fitting **120** and seals orifice **125**. Lumen **18** is blocked by elastomeric valve **20**, preferably implemented as an elastomeric membrane cut along a slit. When the lumen is empty, the slit assumes its normally-closed state, sealing the orifice of the working channel so that suction can be applied via valve **140** to working channel **130** without significant leakage at interface **110**. When a tool is inserted through the lumen, the slit is pushed open, allowing the tool to slide through the membrane and into the working channel. The material of valve **20** is preferably sufficiently flexible to form a seal around the inserted tool.

Both elastomeric valve **20** and the elastomeric clamping block are preferably implemented as a unitary elastomeric insert **11** deployed within housing **13**. The elastomeric material is preferably flexible material such as rubber or silicon. Insert **11** has a central lumen **18** through which tools may be inserted. The elastomeric clamping block is preferably formed as a substantially cylindrical collar **27** around part of central lumen, thereby defining a central clamping bore for passage of the tool. Collar **27** preferably features at least one inwardly projecting ridge **28** projecting into the central clamping bore to enhance clamping.

Collar **27** preferably has conical surface portions (i.e., sloped steps) **29** around its circumference. Tightening mechanism then preferably includes at least one axially displaceable element deployed for engaging the conical surface **29** so as to apply an inward pressure for clamping the tool within the central clamping bore.

In the implementation illustrated here, as best seen in Figure 4, flexible insert **11** is retained within housing **13** by two rings, a lower ring **12** and an axially displaceable upper ring **15**, both deployed for engaging conical surfaces **29**. A screw-nut **16** bears upon the upper ring, displacing it axially downwards. Closing screw-nut **16** pushes the rings one against the other. Downward displacement of lower ring **12** is prevented indirectly by the engagement pressure with fitting **120**. The internal surfaces of the rings are oblique, so when the screw is closed and the rings are pushed tighter, it presses the flexible part **11**, forcing lumen **18** to narrowed. Narrowing lumen **18** locks the tool placed inside the lumen, preventing it from sliding in or out of the lumen. The lower part of housing **13** has a groove **21**, matching the shape of working channel interface **110**. It prevents the apparatus from rotating when tightening screw-nut **16**.

Turning now to the second aspect of the present invention illustrated with reference to Figure 5, this relates to a sheath for use according to the above-mentioned functionality of guiding tools to a point of interest, as described further in the aforementioned PCT patent publication no. WO03/086498. Specifically, it relates to a sheath structure in which the proximal portion **30**, i.e., the portion which remains projecting from the bronchoscope handle, is formed with reduced flexibility compared to the primary sheath portion **32**. This has been found to greatly facilitate the insertion of various devices, such as for the interchanging of the locatable guide and various tools as mentioned above.

Primary sheath portion **32**, which extends along a major portion (and typically more than 80%) of a length of the sheath, is configured by selection of material and dimensions to have a first degree of flexibility suitable for its intended function as is known in the art. Specifically, the primary sheath portion should be sufficiently flexible to negotiate the fine branched structure of the air passageways of the lungs while being stiff enough to allow it to be pushed forwards through passageways and to bend without collapsing the inner lumen.

Reduced flexibility proximal sheath portion **30**, on the other hand, has a lower degree of flexibility as measured, for example, by the extent of flexion caused by a given force applied perpendicular to a cantilevered section of the tube at a given distance from the support point. In practical terms, this ensures that the unsupported length of the sheath projecting from the handle of the bronchoscope while in use is relatively stable and doesn't wave about as much as it would if it was as flexible as the primary sheath portion. This facilitates feeding tools etc. into the sheath. The proximal sheath portion and the primary sheath portion together define a contiguous inner lumen. Most preferably, a proximal end piece **40**, mechanically associated with a proximal end of proximal sheath portion **30**, is shaped to define a conical insertion guide for guiding a tool into the inner lumen, thereby further facilitating insertion of tools etc. into the sheath.

In most preferred implementations, the sheath also has a distal portion **34** which exhibits a higher degree of flexibility than the primary sheath portion to facilitate steering of the sheath via an inserted locatable guide. As a result, the preferred implementation of a sheath according to the present invention exhibits three distinct levels of flexibility.

Structurally, the relatively less flexible proximal portion is preferably implemented by addition of an outer sleeve **36** to the sheath structure. One example of suitable material for a relatively less flexible sleeve is polyamide. Since polyamide is not readily welded to materials typically used for the main portion of the sheath, for example nylon-based materials such as "PEBAX", an implementation as an outer sleeve overlying the inner sheath structure is preferred. The underlying PEBAX structure **38** may optionally be made thinner so that the overall thickness of the sheath does not significantly increase at the less flexible portion. The relatively more flexible distal portion may be implemented by varying the thickness and/or composition of the PEBAX tube, as is known in the art.

Turning now to a further aspect of the present invention, Figures 6-9 illustrate a clip according to the invention, and its use. The clip is designed to enable blind attachment and detachment of a bronchoscopic accessory, including, but not limited to, the system of the aforementioned PCT patent publication no. WO03/086498, which is hereby incorporated fully by reference. The clip provides for hands-free retention of the accessory, thereby freeing the practitioner's hand when it is not being actively used. The clip also preferably allows partial or full operation of the accessory from its retained position. The clip mounts on the shaft of the bronchoscope (Figs. 8 and 9) and does not interfere with normal operation of the bronchoscope.

Structurally, the portion of the clip which attaches to the bronchoscope preferably has a relatively rigid outer bracket **210** for circumscribing at least 180°, and more preferably between about 200° and 250°, around the bronchoscope. Within the outer bracket **210** is mounted a relatively flexible clamping portion **212**, typically also circumscribing at least 180°, and more preferably between about 200° and 250°, around the bronchoscope. The clamping portion **212** is typically a "C"-shaped crosssection, i.e., a partial cylinder open along one side. The clamping portion **212** preferably has a resilient lining or insert **214** of material such as silicone which serves to protect the surface of the endoscope and enhance clamping friction. The clamping portion **212** is closed inwards relative to the outer bracket **210** by a tightening mechanism, typically in the form of a tightening bolt **216** as shown. Optionally, outer bracket **210** and clamping portion **212** may be permanently attached or integrally formed on the side remote from the tightening mechanism.

Attached or integrally formed with one or both of the outer bracket **210** and the clamping portion **212** are a pair of resilient jaws **218** which together make the accessory clip. In the example shown here, the resilient jaws are integrally formed with the clamping portion **212** and pass on opposite sides of the outer bracket **210**. Most preferably, the form of the accessory clip is configured for clamping a substantially cylindrical body portion of an accessory in an orientation substantially perpendicular to a central axis of the bronchoscope handle/body. This maximizes the accessibility of the accessory device for operation while attached to the clip.

The outer bracket **210**, the clamping portion **212** and the accessory clip may be made out of any suitable material, and may all be of the same material or a combination of different materials. Particularly preferred choices of materials include, but are not limited to, stainless steel, aluminum and plastics.

Turning now to a final aspect of the present invention, Figures 10-13 illustrate a wrap-around handle extension **220** for use with a bronchoscope handle. Generally speaking, wrap-around handle extension **220** helps the bronchoscopist in holding with one hand the bronchoscope's handle and concurrently the handle of the bronchoscope tool, and operating the two without them interfering with each other, while leaving the second hand free for any additional required action. To this end, handle extension **220** includes a flexible wrap-around layer **228** provided with complementary fastening arrangements **224** deployed so as to form a conical sleeve (Figure 11) for holding the bronchoscope handle as shown in Figures 12 and 13. Handle extension **220** also includes a hand loop **222** associated with the flexible wrap-around layer **228** and configured for receiving the hand of a user to allow suspension of the conical sleeve from the hand of the user.

Referring to the example illustrated herein in more detail, flexible wrap-around layer **228** is preferably implemented as a thin layer of soft plastic foam. Hand loop **222** is typically formed from similar foam material. Complementary fastening arrangements **224** are preferably implemented as complementary regions of a Velcro fastening arrangement, although other arrangements of straps or fasteners may be used.

Wrap-around handle extension **220** preferably also includes an accessory suspension strap **226** associated with flexible wrap-around layer **228** and configured for suspending an accessory from the conical sleeve (see Figure 12). Accessory suspension strap **226** is preferably configured with a releasable fastening configuration (for example Velcro) to form a releasable suspension loop. In a particularly preferred implementation as shown here, accessory suspension strap **226** is implemented as an extending tail of one of the Velcro straps of fastening arrangement **224**.

As mentioned before, wrap-around layer **228** forms a conical sleeve designed to wrap and fit to the handle of the bronchoscope **240**. When the bronchoscope in used for navigation, the bronchoscopic tool **242** is installed hanging in loop **226** as shown in Figure 12. This allows the bronchoscopist to manipulate the bronchoscope with both hands without being burdened by the bronchoscopic tool, although he is holding that tool as well. When the tip of the bronchoscope reaches to the target, the bronchoscopist put his palm inside the handle **222** so the bronchoscope hangs, or rests, on the back of his hand. Now the bronchoscopist may operate the bronchoscopic tool **242** using his free fingers, as shown in Figure 13.

The implementation illustrated herein is preferably a single-use disposable accessory. Other similar implementations, using different materials and different techniques for attaching the bronchoscopic tool to the bronchoscope's handle also fall within the scope of the present invention. In each case, the handle extension employs similar principles in that the handle of the tool is suspended in a position that does not interfere with the physician's use the bronchoscope for navigation inside the lungs, and yet after reaching to the target lets the physician operate the bronchoscopic tool using the same hand while still holding the bronchoscope's handle.

Although the above aspects of the present invention have been described in the context of a bronchoscope and bronchoscopic tools, it should be appreciated that other applications using other type of endoscopes and endoscopic tools, in which it is required to hold the tools and the endoscope handle at the same time, also fall within the scope of the present invention.

It will be appreciated that the above descriptions are intended only to serve as examples, and that many other embodiments are possible within the scope of the present invention as defined in the appended claims.

WHAT IS CLAIMED IS:

1. A sealing and locking adapter for attachment to an access port of a working channel of a bronchoscope to allow insertion and locking of a tool while sealing the access port when not in use, the adapter comprising:

(a) a housing configured for mating with the access port of the working channel of the bronchoscope;

(b) an attachment configuration associated with said housing and configured for attaching said housing to the access port of the working channel;

(c) a sealing arrangement deployed within said housing, said sealing arrangement including an elastomeric valve elastically biased to a normally-closed state wherein said elastomeric valve forms part of a sealing arrangement for resisting passage of air through the access port of the working channel, said elastomeric valve being configured to allow insertion of the tool through said valve and into the working channel; and

(d) a clamping arrangement deployed within said housing, said clamping arrangement including an elastomeric clamping block and a tightening mechanism, said tightening mechanism being manually operable to deform said elastomeric clamping block so as to lock in position the tool inserted through said housing and into the working channel.

2. The adapter of claim 1, wherein said elastomeric clamping block is formed as a substantially cylindrical collar with a central clamping bore for passage of the tool.

3. The adapter of claim 2, wherein said central clamping bore features at least one inwardly projecting ridge.

4. The adapter of claim 2, wherein said substantially cylindrical collar has at least one conical surface portion, said tightening mechanism including an axially

displaceable element deployed for engaging said at least one conical surface so as to apply an inward locking pressure on said central clamping bore.

5. The adapter of claim 1, wherein said elastomeric valve and said elastomeric clamping block are implemented as a unitary elastomeric insert deployed within said housing.

6. The adapter of claim 1, wherein said elastomeric valve is implemented as an elastomeric membrane cut along a slit.

7. A clip for temporarily retaining a substantially cylindrical body portion of an accessory in predefined relation to a handle of a bronchoscope, the clip comprising:

(a) an outer bracket configured for circumscribing at least 180° around the handle of the bronchoscope;

(b) a flexible clamping portion deployed within said outer bracket and circumscribing at least 180° around the handle of the bronchoscope;

(c) a tightening mechanism associated with said outer bracket and configured to flex at least part of said flexible clamping portion inwards relative to said outer bracket so as to clamp the clip onto the handle of the bronchoscope; and

(d) a pair of resilient jaws interconnected with at least one of said outer bracket and said flexible clamping portion, said pair of resilient jaws being configured for gripping an accessory.

8. The clip of claim 7, further comprising a resilient insert deployed within said clamping portion.

9. The clip of claim 7, wherein said pair of resilient jaws is integrally formed with said flexible clamping portion.

10. The clip of claim 7, wherein said pair of resilient jaws is configured to grip the substantially cylindrical body portion of the accessory substantially perpendicular to a direction of elongation of the bronchoscope handle.

11. The clip of claim 7, wherein said flexible clamping portion circumscribes at least about 200° around the handle of the bronchoscope.

12. The clip of claim 7, wherein said flexible clamping portion circumscribes no more than about 250° around the handle of the bronchoscope.

13. A wrap-around handle extension for use with a bronchoscope handle, the wrap-around handle extension comprising:

(a) a flexible wrap-around layer provided with complementary fastening arrangements deployed so as to form a conical sleeve for holding the bronchoscope handle; and

(b) a hand loop associated with said flexible wrap-around layer and configured for receiving the hand of a user to allow suspension of said conical sleeve from the hand of the user.

14. The handle extension of claim 13, wherein said complementary fastening arrangements are implemented as complementary regions of a Velcro fastening arrangement.

15. The handle extension of claim 13, further comprising an accessory suspension strap associated with said flexible wrap-around layer and configured for suspending an accessory from said conical sleeve.

16. The handle extension for claim 15, wherein said accessory suspension strap is configured with a releasable fastening configuration to form a releasable suspension loop.

17. A sheath for deployment via a working channel of a bronchoscope for directing a tool to a previously identified position, the sheath comprising:

(a) a primary sheath portion extending along a major portion of a length of said sheath, said primary sheath portion having a first degree of flexibility; and

(b) a reduced flexibility proximal sheath portion, said proximal sheath portion and said primary sheath portion together defining a contiguous inner lumen, said proximal sheath portion having a lower degree of flexibility than said primary sheath portion.

18. The sheath of claim 17, wherein said primary sheath portion is implemented as a tube formed from a first material, and wherein said proximal sheath portion is implemented as a continuation of said tube formed from said first material circumscribed by a reinforcing sleeve of a second material.

19. The sheath of claim 17, further comprising a distal sheath portion forming a contiguous inner lumen with said primary sheath portion, said distal sheath portion having a higher degree of flexibility than said primary sheath portion.

20. The sheath of claim 17, further comprising a proximal end piece mechanically associated with a proximal end of said proximal sheath portion, said proximal end piece defining a conical insertion guide for guiding a tool into said inner lumen.

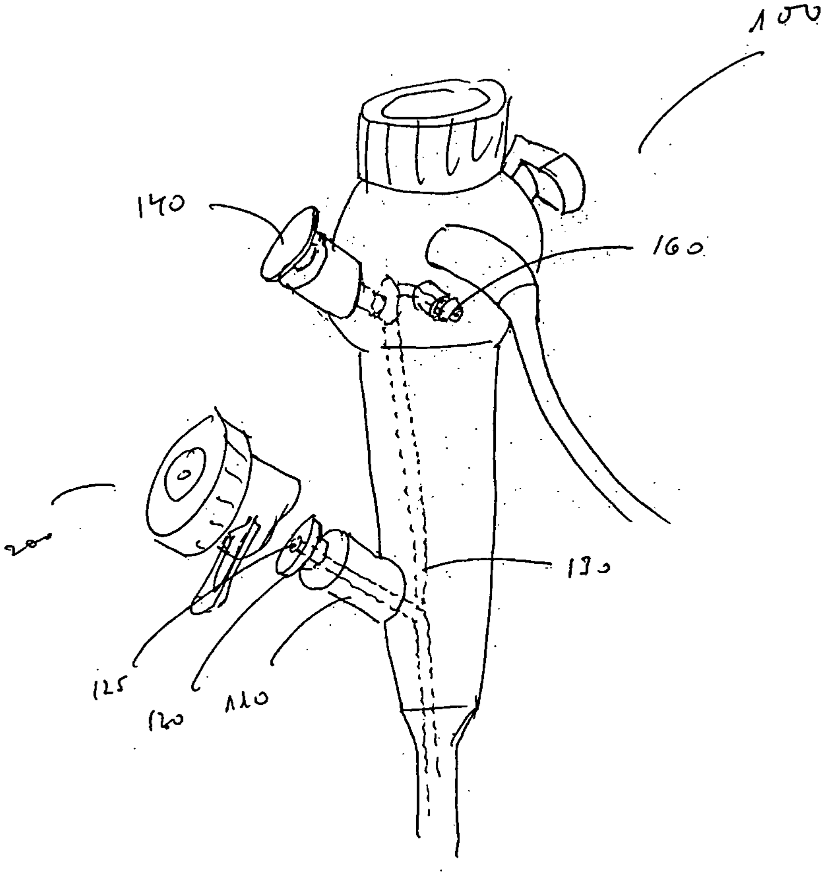


Figure 1

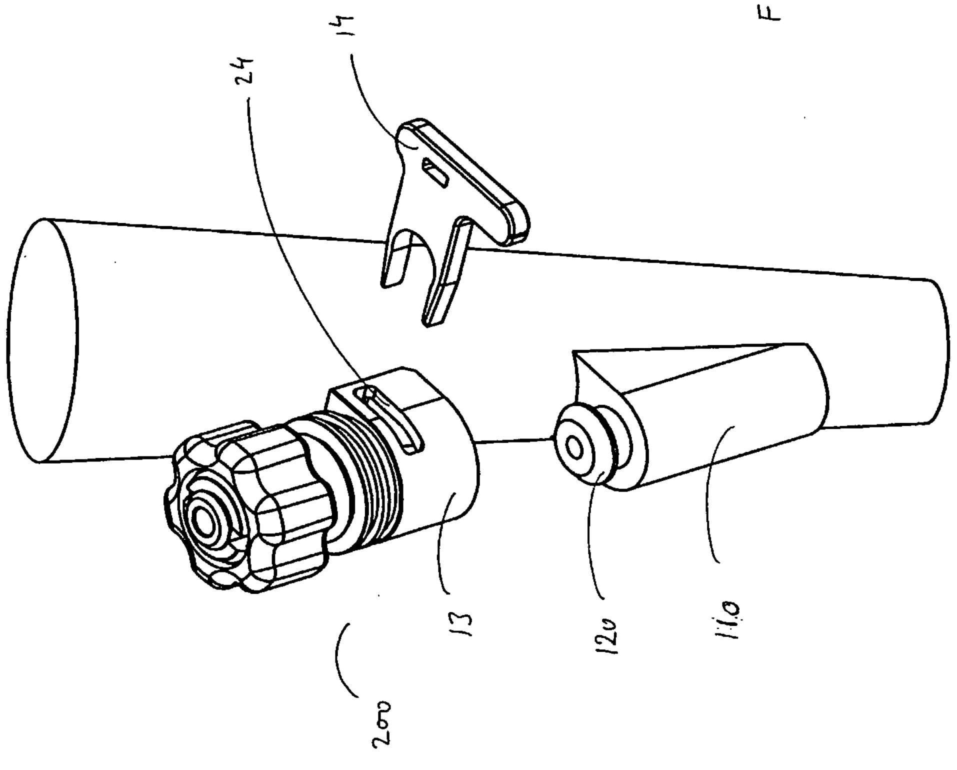


Figure 2A

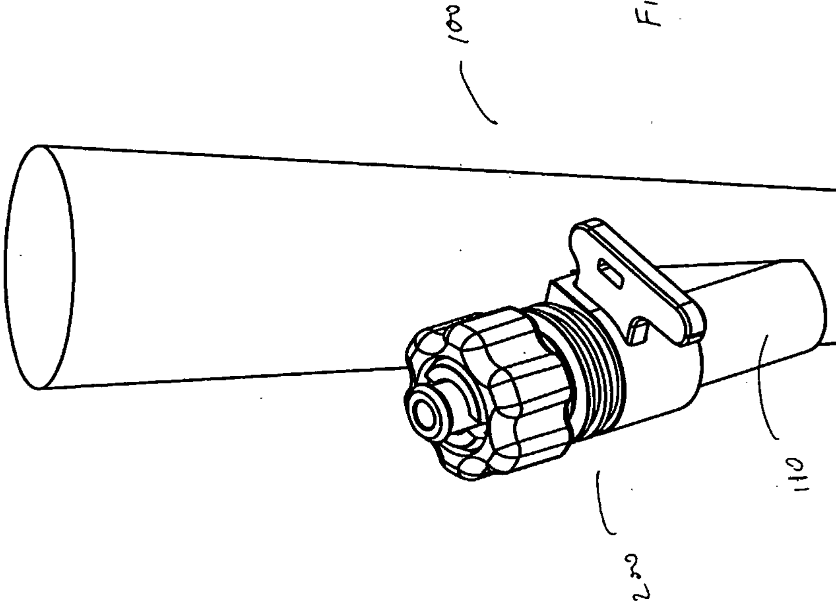


Figure 2B

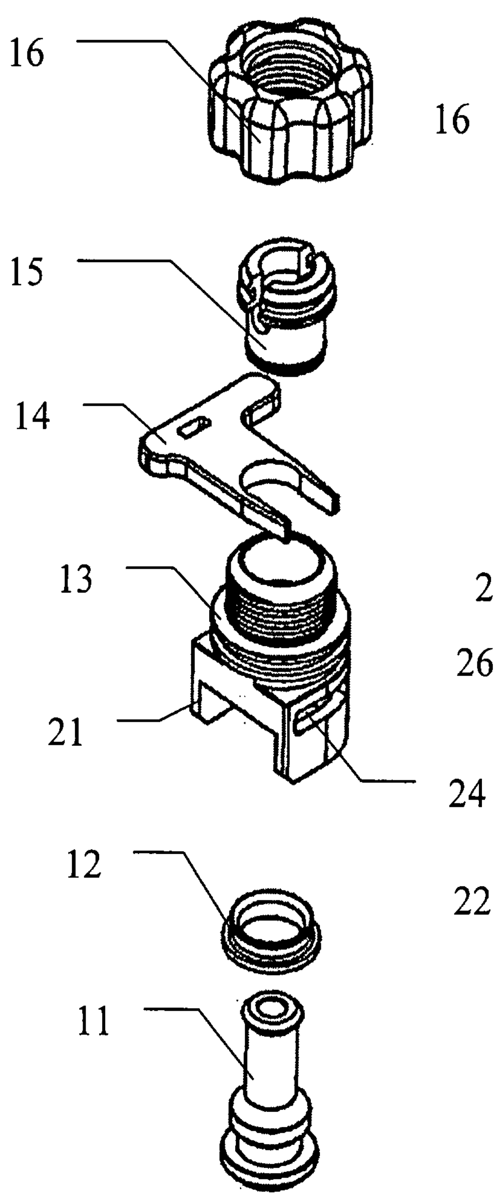


Figure 3A

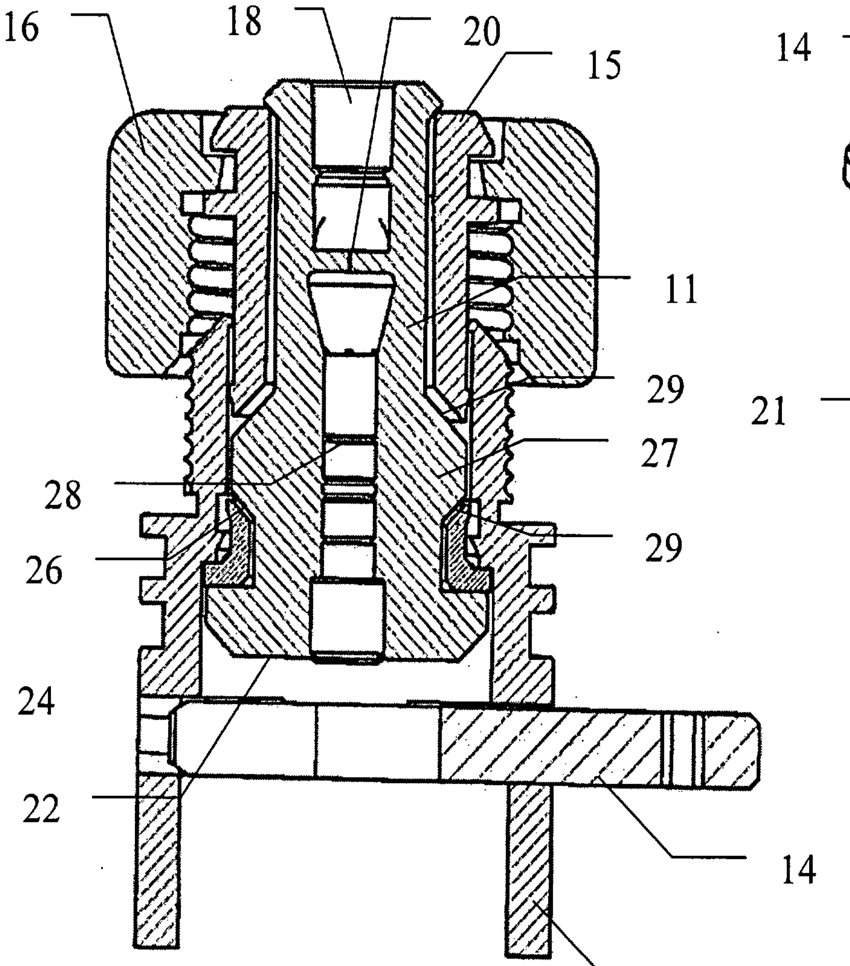


Figure 4

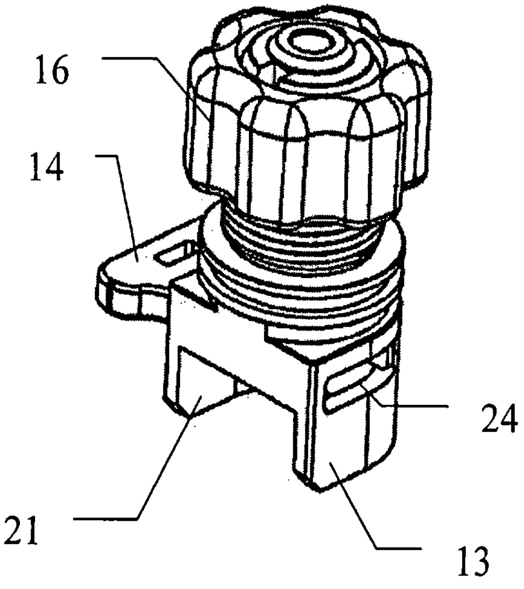


Figure 3B

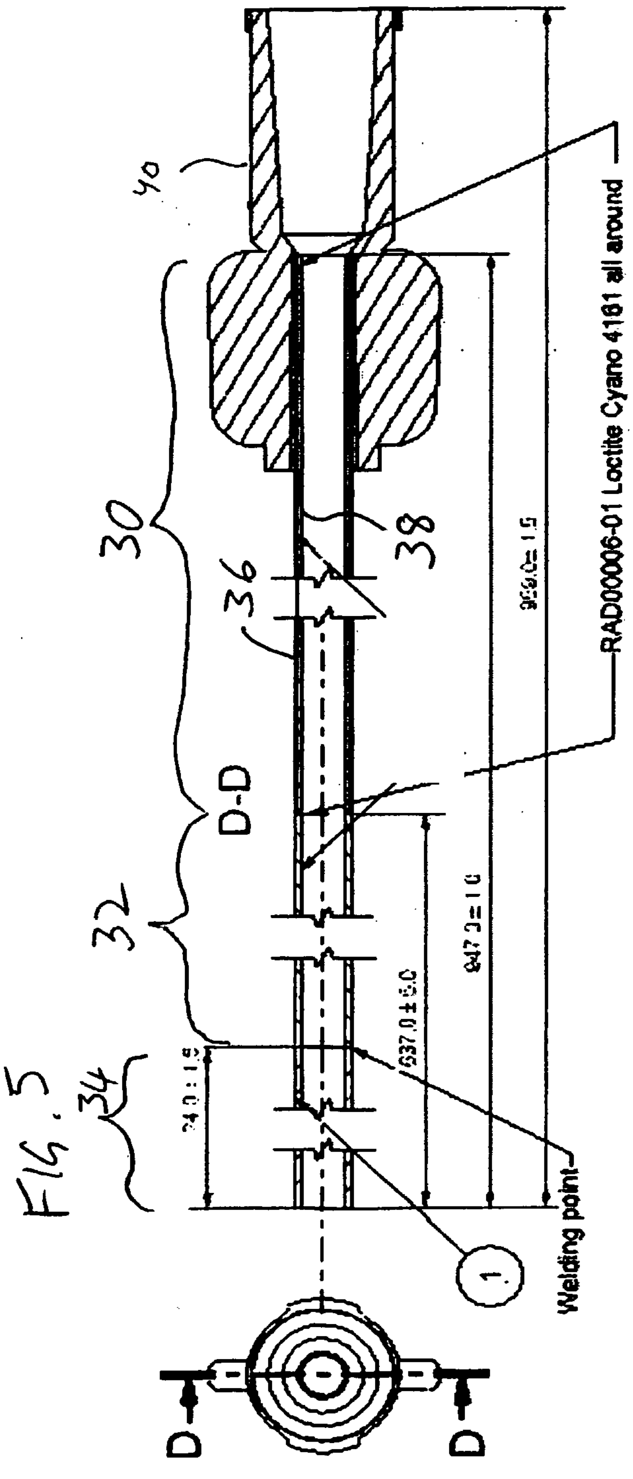

40
30
36
38
D-D
32
34
RAD00006-01 Loctite Cyano 4161 all around
958.0±1.5
847.0±1.0
637.0±5.0
24.0±1.5
Welding point
1.
D
D

FIG. 5

FIG. 6

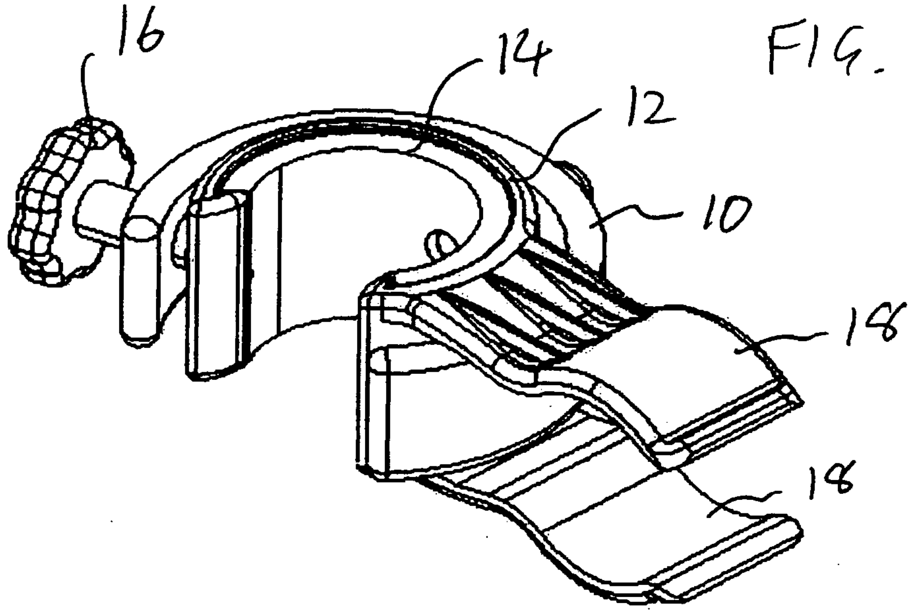


FIG. 7

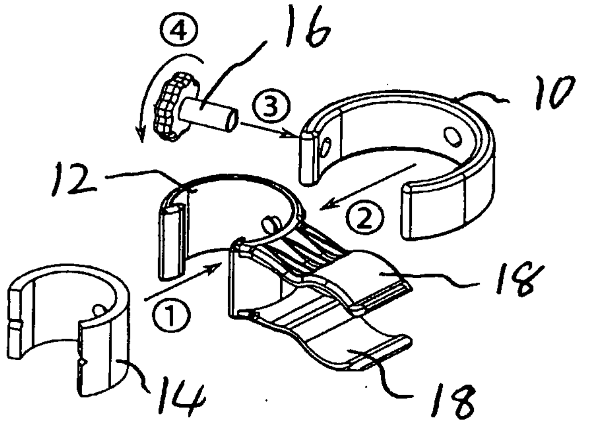


FIG. 8

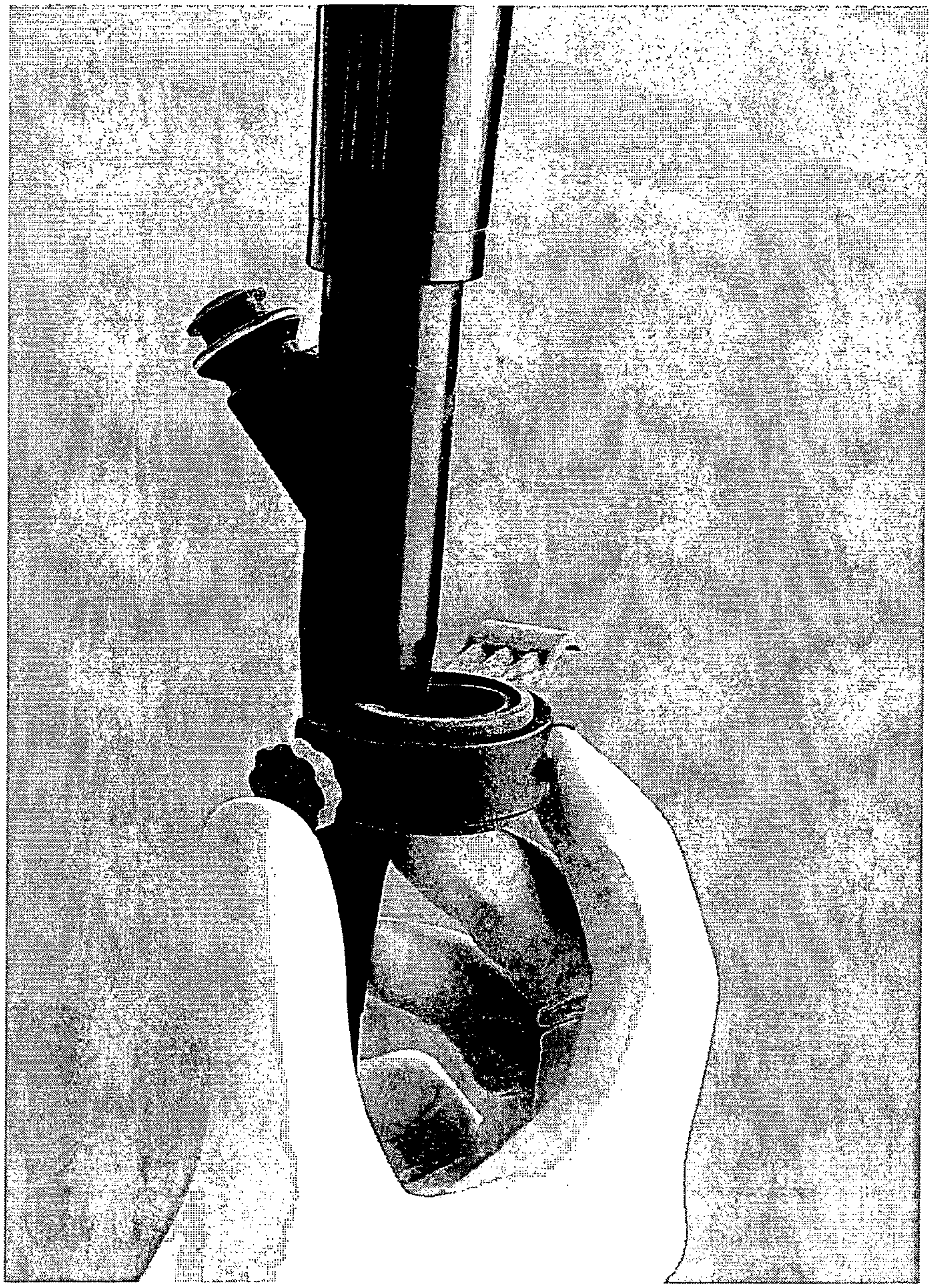
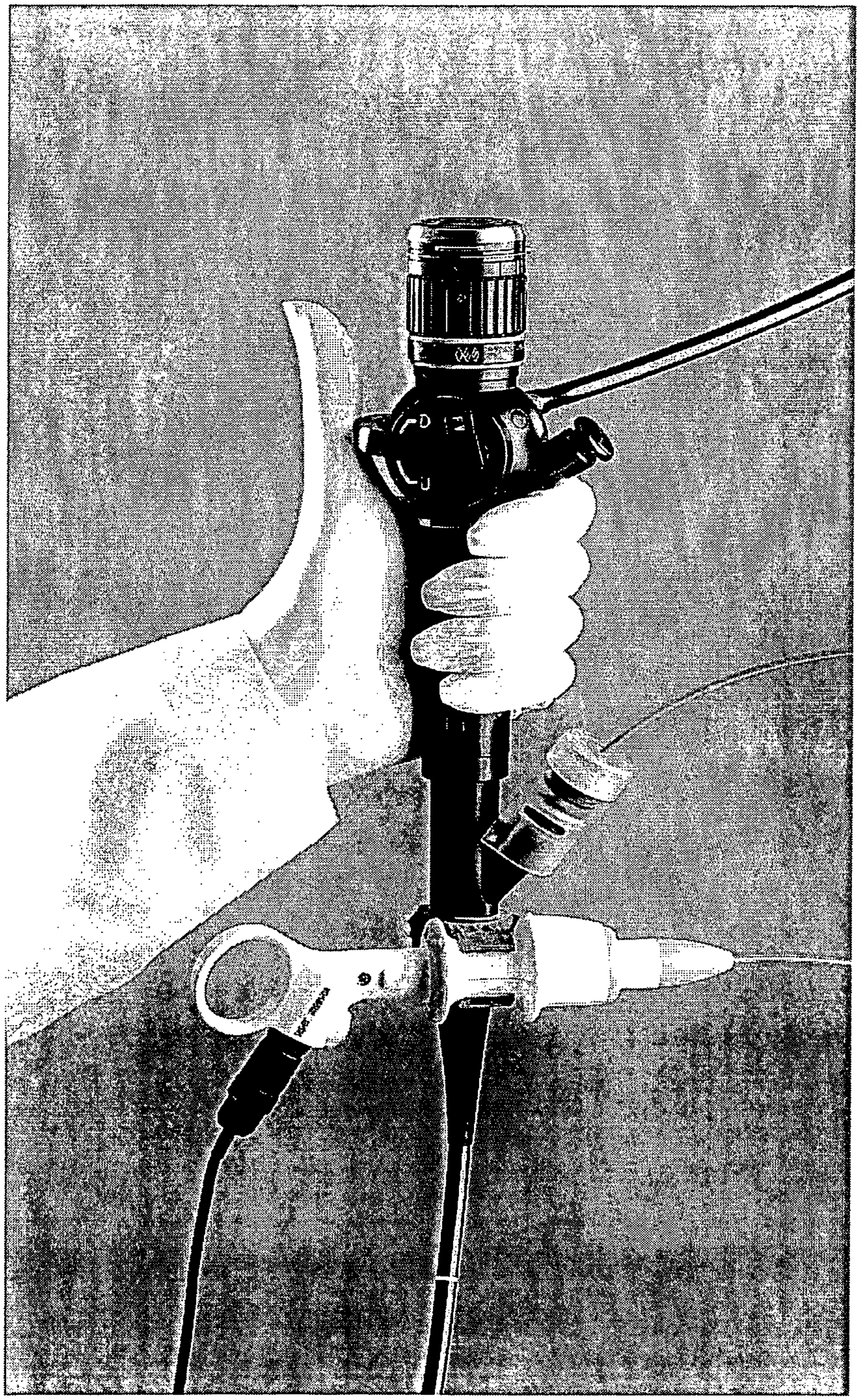


FIG. 9



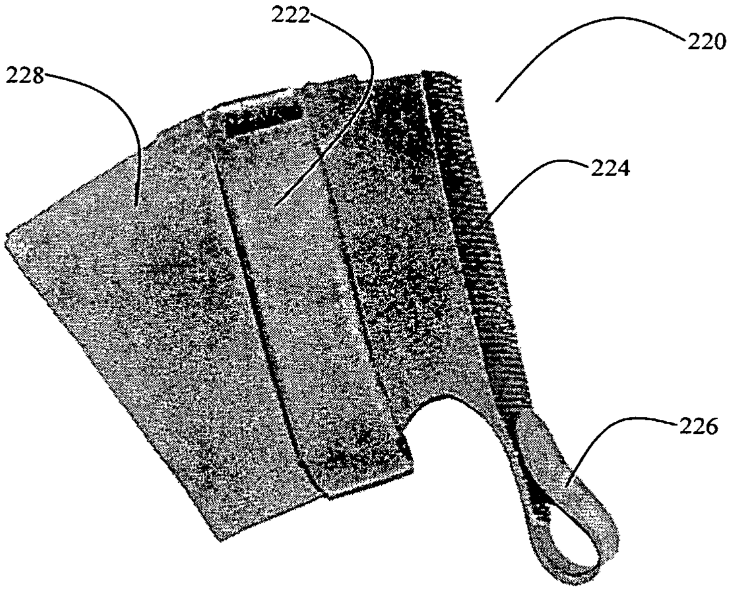


Figure 10

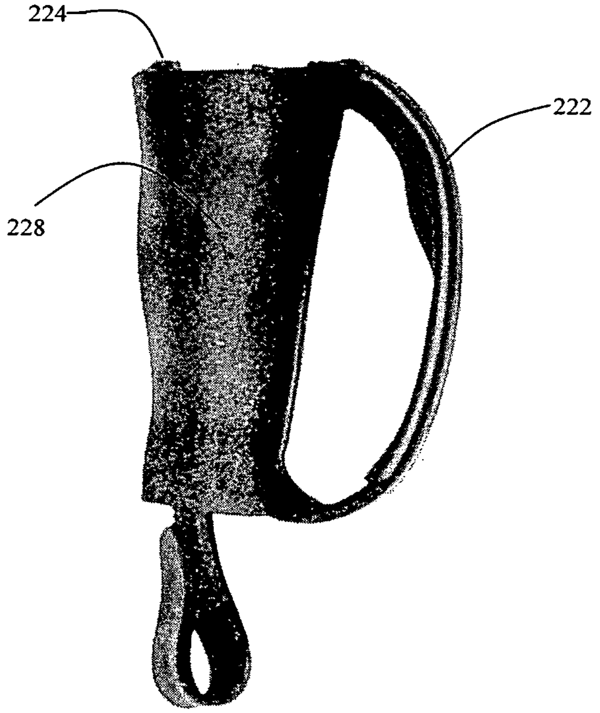


Figure 11

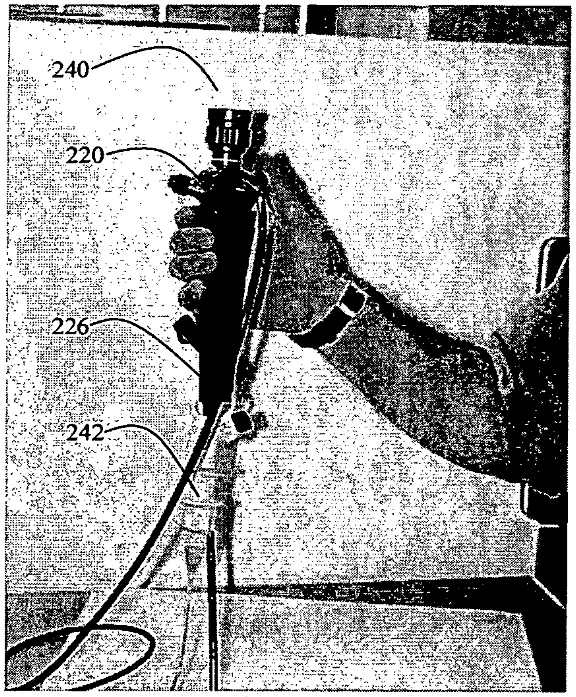


Figure 12

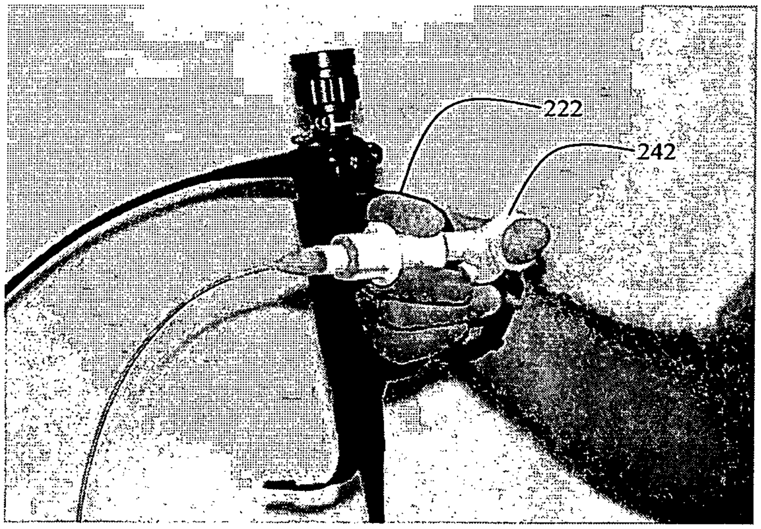


Figure 13